

WHAT IS CLAIMED IS:

- 1 1. A search method comprising the acts of:
  - 2 a) using N bits, N being an integer, from a packet as an index into a data structure
  - 3 including a Direct Table with at least one entry and a tree structure operatively
  - 4 coupled to said one entry;
  - 5 b) setting a threshold based upon a first predetermined characteristic of the tree
  - 6 structure;
  - 7 c) using select bits from the packet to traverse said tree structure until the threshold
  - 8 is met;
  - 9 d) storing in a Contents Address Memory (CAM) at least one entry based upon a
  - 10 predetermined characteristic of the packet and a second predetermined
  - 11 characteristic of said tree structure; and
  - 12 e) using the at least one entry to access a memory location whereat action to be taken
  - 13 relative to the packet is stored.
- 1 2. The method of Claim 1 wherein N includes the first sixteen bits of a Destination MAC
- 2 Address.
- 1 3. The method of claim 2 wherein the tree structure includes a plurality of nodes and leaves
- 2 operatively coupled to selected nodes.

- 1 4. The method of claim 3 further including Pattern Search Control Blocks (PSCBs) carrying  
2 search information positioned at selected nodes.
- 1 5. The method of Claim 1 wherein the first predetermined characteristic includes nodes and  
2 the threshold is set to a count of the nodes.
- 1 6. The method of Claim 2 wherein the selected bits include the remaining thirty two bits of  
2 the Destination MAC Address.
- 3 7. The method of Claim 2 wherein the second predetermined characteristic includes leaves.
- 4 8. A method for correlating a search key with a database comprising the acts of:
- 5 a) using  $N$  bits,  $N \geq 1$ , from the search key as an index into the database including  
6 entries having a Direct Table with at least one entry and a tree structure  
7 operatively coupled to said one entry;
- 8 b) setting a threshold based upon a first predetermined characteristic of the tree  
9 structure;
- 10 c) using  $M$  bits ( $M > 1$ ) from the search key to access said tree structure until the  
threshold is met; and
- d) reading from a CAM information that indicates action to be taken relative to the  
search key.

- 1 9. The method of claim 8 wherein the search key includes a portion of a data packet.
- 1 10. The method of claim 9 wherein the information includes the address of a leaf in which the  
2 action is stored.
- 1 11. The method of claim 8 wherein the reading step further includes the step of using the N  
2 bits as index into the CAM.
- 3 12. An apparatus comprising:  
4 an embedded processor complex including a plurality of protocol processors;  
5 a control point processor operatively coupled to the processor complex;  
6 a plurality of hardware accelerator co-processors accessible to each protocol  
processor and providing high speed pattern searching, data manipulation and frame  
parsing;  
7 at least one memory device, operatively coupled to the processor complex, that  
8 stores data structures including a Direct Table, nodes and leaves operatively chained  
9 together; and  
10 a Memory location operatively coupled to the processor complex and storing a  
11 value representative of the maximum number of nodes to be accessed during a tree search  
12 routine.

1 13. The apparatus of claim 12 further including a Contents Address Memory (CAM)  
2 operatively coupled to the processor complex and storing a pointer identifying a location  
3 whereat a leaf is stored.

1 14. The apparatus of claim 13 wherein the leaf contains information on actions to be taken  
2 relative to a packet.

15. The apparatus of claim 14 wherein the CAM further includes an indicia paired with the  
pointer, said indicia being selected from a portion of the packet.

16. The apparatus of Claim 15 wherein the indicia includes a portion of a Destination MAC  
Address in the packet.

17. The apparatus of Claim 15 further including a circuit that deletes pointers from the CAM  
based upon leaf adjustments in the tree structure and/or NONE use of the information  
within a predetermined time interval.

1 18. The apparatus of Claim 17 wherein the leaf adjustments include deletion.

- 1 19. The apparatus of Claim 12 wherein the Control Point Processor is programmed to  
2 generate and forward frames containing information that adjusts the data structure.
- 1 20. The apparatus of Claim 19 wherein the adjustment includes leaf deletion and/or insertion.
- 1 21. A data structure comprising:  
2 a Direct Table having at least two entries;  
3 a tree structure operatively coupled to the at least two entries and having a  
4 plurality of nodes and leaves operatively chained together; and  
5 a storage storing a threshold value indicating the maximum number of nodes to be  
6 accessed during a walk of said tree structure.
- 7 22. The data structure of Claim 21 further including Contents Address Memory, CAM, in  
8 which leaf information is stored if the leaf is connected to a node above the threshold  
9 value.  
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1 23. The data structure of Claim 22 further including a co-processor responsive to at least a  
2 command to use part of the DA of a packet to index into the DT and the remaining part of  
3 said DA to search the associated tree, said co-processor selecting, information stored in a  
4 leaf if the leaf is attached to a node below the threshold value or selecting information  
5 stored in the CAM if the leaf is attached to a node above the threshold value.

1 24. A system comprising:

2 a processor to provide a key extracted from a data packet;

3 a tree walk logic responsive to use the key to walk a tree structure until a  
4 threshold is reached;

5 a CAM controller to use the key to search a CAM; and

6 a controller that uses the first available result from the tree walk logic or the CAM  
7 controller to determine an action to be taken relative to the data packet.

1 25. A search method comprising the acts of:

2 (a) providing a key extracted from a data packet;

3 (b) using said key by a tree walk logic to search a tree structure until a threshold is  
4 reached;

5 (c) using said key by a CAM controller to search a CAM; and

6 using the first result from acts (b) or (c) to determine an action to be taken relative to the  
7 data packet.